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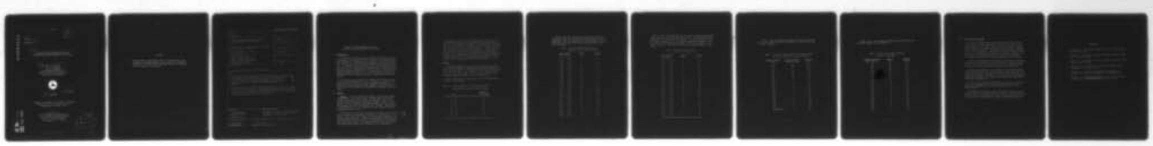

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REFRACTIVE ERROR CHARACTERISTICS OF EARLY AND ADVANCED PRESBYOPIC INDIVIDUALS

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16. Abstract

The frequency and distribution of ocular refractive errors among middle-aged and older people were obtained from a nonclinical population holding a variety of blue-collar, clerical, and technical jobs. The 422 individuals [illegible] in age from 35 to 69 years and were volunteers for several vision res[illegible]tudies conducted primarily at the FAA Civil Aeromedical Institute in Okla[illegible]ty, Oklahoma.

Data include frequency of various spherical (hyperopic or myopic) and astigmatic refractive errors, including differences in refractive errors in pairs of eyes. These data, together with information provided by other investigators, will allow a realistic assessment of the distribution of refractive errors and expected visual acuities in the adult population.

17. Key Words

Refractive Error
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REFRACTIVE ERROR CHARACTERISTICS OF
EARLY AND ADVANCED PRESBYOPIC INDIVIDUALS

I. Introduction.

A recent article by Grosvenor (1) indicates a paucity of data concerning the incidence of ocular refractive errors among middle-aged individuals. Furthermore, he states that data obtained from an unselected or nonclinical adult population are almost nonexistent. To expand the data available for this age group, we made a survey of records compiled from approximately 500 individuals who had volunteered to participate in several visual research projects conducted during 1975 and 1976. From this group, 422 individuals were identified as being in the 35-to-69 years age range and as having data sheets containing adequate information on refractive errors.

The data have been tabulated to indicate the following distributions: age distribution by 5-year intervals; frequency of distant refractive errors for all eyes; algebraic differences in refractive errors in pairs of eyes; smallest refractive error in either eye of all subjects; and frequency of astigmatic refractive errors.

II. Methods.

Subjects. The 422 individuals included in this survey ranged in age from 35 to 69 years at last birthday (mean 48.9 years). Females accounted for 21.3 percent of the sample. Most of the individuals were government employees holding a variety of blue-collar, clerical, technical, and administrative positions at the FAA Aeronautical Center in Oklahoma City, Oklahoma. Approximately 50 individuals were not so employed but were evaluated during an Oklahoma air show in 1975.

The majority of individuals (88 percent) included in this survey were recruited by announcements published in the employees' newsletter. The subjects were asked to perform simple readability and visual recognition tasks. Volunteers obtained at the Oklahoma air show were asked to participate in a questionnaire study and submit to a visual acuity test. No tangible benefits other than a brief vision test were promised as an inducement for participation.

Procedure. Volunteers for the various research studies were given a manifest refraction by an optometrist using standard objective and subjective techniques. The individuals' hyperopic, myopic, and/or astigmatic refractive errors were determined for each eye for a 6-m (20 ft) viewing distance. In some instances, when a complete evaluation was not made on an individual, the refractive error was obtained by measuring the individual's spectacle lens correction for distance vision with a lensometer. Lensometry data were included only when the lenses corrected visual acuity to 20/20 or better at 6 m as measured by an ophthalmic acuity projector or a Titmus Vision Tester.

III. Results.

Following established practice, we are reporting the refractive errors as spherical equivalents so that the astigmatic error (cylinder power) is included at half value with the spherical refractive error. For example, if the refractive error of an eye is +1.25 D sphere, -1.00 D cylinder, axis 30°, the spherical equivalent would be +0.75 D of hyperopia.

Table 1 shows the age distribution of the 422 individuals included in the survey.

TABLE 1. Age Distribution of Individuals Included in Survey Based on Age at Last Birthday

AGE	NUMBER OF INDIVIDUALS
35 - 39	23
40 - 44	116
45 - 49	95
50 - 54	89
55 - 59	63
60 - 64	27
65 - 69	9

Table 2 gives the distribution of spherical equivalent refractive errors for both eyes of 420 individuals. Two individuals were not included for lack of reliable refractive error data. The range and mean age remained the same for the full sample.

TABLE 2. Distribution of Refractive Errors (Spherical Equivalent) for 840 Eyes From 420 Individuals

RANGE OF REFRACTIVE ERROR (Diopters)		NUMBER OF EYES	PERCENTAGE OF TOTAL
-10.00 to	-10.87	1	0.1
- 9.00	- 9.87	3	0.4
- 8.00	- 8.87	6	0.7
- 7.00	- 7.87	1	0.1
- 6.00	- 6.87	3	0.4
- 5.00	- 5.87	13	1.5
- 4.00	- 4.87	13	1.5
- 3.50	- 3.87	11	1.3
- 3.00	- 3.37	14	1.7
- 2.50	- 2.87	20	2.4
- 2.12	- 2.37	14	1.7
- 1.75	- 2.00	23	2.7
- 1.37	- 1.62	33	3.9
- 1.00	- 1.25	48	5.7
- 0.62	- 0.87	41	4.9
- 0.25	- 0.50	142	16.9
- 0.12	+ 0.12	132	15.7
+ 0.25	+ 0.50	119	14.2
+ 0.62	+ 0.87	45	5.4
+ 1.00	+ 1.25	59	7.0
+ 1.37	+ 1.62	28	3.3
+ 1.75	+ 2.00	19	2.3
+ 2.12	+ 2.37	21	2.5
+ 2.50	+ 2.87	9	1.1
+ 3.00	+ 3.37	9	1.1
+ 3.50	+ 3.87	5	0.6
+ 4.00	+ 4.87	2	0.2
+ 5.00	+ 5.87	4	0.5
+ 6.00	+ 6.87	1	0.1
+ 7.00	+ 7.87	1	0.1

Table 3 shows the distribution of the smallest spherical equivalent refractive error in each of 399 pairs of eyes. Those individuals with mixed refractive errors were not included. A mixed refractive error is defined, on the basis of the spherical equivalent refractive error, as a pair of eyes having one hyperopic eye and one myopic eye. Age range remained 35 to 69 years but the mean increased slightly to 49.0 years.

TABLE 3. Distribution of Smallest Refractive Error in Each of 399 Pairs of Eyes

RANGE OF REFRACTIVE ERROR (Diopters)	NUMBER OF EYES	PERCENTAGE OF TOTAL
- 9.00 to - 9.87	1	0.3
- 8.00 - 8.87	3	0.8
- 7.00 - 7.87	1	0.3
- 6.00 - 6.87	1	0.3
- 5.00 - 5.87	4	1.0
- 4.00 - 4.87	6	1.5
- 3.50 - 3.87	4	1.0
- 3.00 - 3.37	10	2.5
- 2.50 - 2.87	9	2.3
- 2.12 - 2.37	5	1.3
- 1.75 - 2.00	7	1.8
- 1.37 - 1.62	17	4.3
- 1.00 - 1.25	23	5.8
- 0.62 - 0.87	18	4.5
- 0.25 - 0.50	59	14.8
- 0.12 + 0.12	91	22.8
+ 0.25 + 0.50	51	12.8
+ 0.62 + 0.87	17	4.3
+ 1.00 + 1.25	27	6.8
+ 1.37 + 1.62	14	3.5
+ 1.75 + 2.00	10	2.5
+ 2.12 + 2.37	9	2.3
+ 2.50 + 2.87	3	0.8
+ 3.00 + 3.37	5	1.3
+ 3.50 + 3.87	1	0.3
+ 4.00 + 4.87	1	0.3
+ 5.00 + 5.87	1	0.3
+ 6.00 + 6.87	1	0.3

* Individuals with mixed refractive errors were not included.

Table 4 shows the algebraic difference between the two eyes of the 420 individuals whose distribution of refractive errors is shown in Table 2.

TABLE 4. Distribution of Algebraic Differences of Refractive Errors in 420 Pairs of Eyes (Based on Spherical Equivalents)

ALGEBRAIC DIFFERENCE (*Diopters*)	PAIRS OF EYES HAVING DIFFERENCES AS SHOWN	PERCENTAGE OF TOTAL
0.00	103	24.5
0.12	79	18.8
0.25	93	22.1
0.37	33	7.9
0.50	44	10.5
0.62	15	3.6
0.75	19	4.5
0.87	8	1.9
1.00	6	1.4
1.12	2	0.5
1.25	6	1.4
1.37	0	0.0
1.50	3	0.7
1.62	1	0.2
1.75	0	0.0
1.87	0	0.0
2.00	4	1.0
2.12	0	0.0
2.25	0	0.0
2.37	1	0.2
2.50	1	0.2
2.62 and greater	2	0.5

Table 5 gives the cylindrical refractive errors for all eyes of the full sample (422 individuals).

TABLE 5. Distribution of Astigmatic Refractive Errors in 422 Individuals

CYLINDRICAL REFRACTIVE ERROR (Diopters)	NUMBER OF EYES	PERCENTAGE OF TOTAL
0.00	324	38.4
0.25	84	10.0
0.50	201	23.8
0.75	83	9.8
1.00	77	9.1
1.25	25	3.0
1.50	10	1.2
1.7[illegible]	10	1.2
2.00	4	0.5
2.25	3	0.4
2.50	10	1.2
2.75	3	0.4
3.00	1	0.1
3.25	0	0.0
3.50	5	0.6
3.75	1	0.1
4.00	0	0.0
4.25	0	0.0
4.50	0	0.0
4.75	0	0.0
5.00	3	0.4

IV. Discussion and Summary.

The sample resulting from this survey seemingly differs from those based on clinical populations in that the individuals were predominantly free from known and/or uncorrected visual or pathological defects. The sample may, however, be described as partly self-selective in that the individuals were not randomly selected from the adult population. The absence of extreme visual or optical defects may be attributed in part to the fact that the sample was drawn largely from a gainfullv employed population engaged in occupations that require at least moderately good visual acuity.

A minor bias may have been introduced in that those individuals excluded from the survey for lack of complete or adequate records (38 subjects) would mostly have fallen into the categories of the smaller refractive errors based on visual acuity performance.

Articles by Grosvenor (1) and Sorsby (2) discuss many aspects of refractive anomalies including incidence by age, sex, and race; ocular components that determine the error; changes with age; and corrective techniques. Hirsch (3) cites previous research endeavors concerning refractive error anomalies and notes areas requiring additional investigation.

We feel that these data, together with information provided by other investigators, will allow a realistic assessment of the frequency and distribution of ocular refractive errors in the adult population.

Information concerning the mean and range of unaided distance visual acuities for various refractive errors can be obtained from several sources, including Hirsch (4) for myopic errors and Pincus (5) and Borish (6) for hyperopic, myopic, and astigmatic errors.

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